ARROWS AND ARROW-MAKERS.

INTRODUCTION

BY OTIS T. MASON.

A great deal has been written about the bow. Mr. Murdoch, of the Anthropological Society, published an elaborate paper on the Eskimo sinew-backed bow; Mr. Balfour, of Oxford, has recently discussed the compound bows of the world.

Down to the fifteenth century the arrow was the most celebrated and most widely distributed missile of destruction, when it began to be displaced by the bullet. Before it gave place to fire-arms, I have no doubt it wrought more death than the substitute has since produced.

The displacement of the arrow was tardy even in the birth-place of fire-arms and was brought about, not by the facility with which the musket could be handled, but by the efficiency of armor. In that perpetual conflict between offense and defense in the enginery of war, defense had been able to quench all the fiery darts of the adversary; the arrow could not pierce the harness of the enemy. At this point came the bullet, slow and not sure; the English archer could discharge thirty arrows while the arquebusier was making a single shot. But when he did get the machine to go off, and, peradventure, if the missle struck its mark, it penetrated any known armor. Its terrible noise and longer range were also in its favor. In lands distant from the center of European culture the arrow has not yet disappeared, and the day of its birth is hidden in the remotest past.

The continent of America furnished the best of facilities for the development of this winged messenger of death. Every variety of climate, material, and game are here to create an indefinite diversity of structures. In its simplest form the arrow is a straight rod, pointed perhaps in the fire. Such a missile would be of little worth

and could not be aimed with any certainty. The most highly developed examples in America consist of:

Head, involving point, faces, facets, sides, butt, tang, barbs, barb-piece.

Seizing.

Foreshaft.

Shaft, involving shaft streaks.

Shaftment, involving riband or owner marks.

Feather, including seizing, glue, and rifling.

Nock, including the footing.

Notch.

Each of these parts may be varied in *number, form, material, or artistic finish*, and one or more of them may be wanting. It will be seen at once what an excellent instrument the arrow is for the study of the natural history of invention; how it has been influenced by climate, natural scenery, and material resources; how it has modified with function, and developed complexity with age. (Fig. 5.)

VOCABULARY OF THE ARROW.

Arrow, a missile shot from a bow. The possible parts are the head, barb-piece, foreshaft, shaft or stele, feathering, nock, and seizings.

Arrow cement, substance used in fastening the arrow-head to the shaft. A few tribes use glue or cement in making the sinew-backed bow.

Arrow-head, the part of an arrow designed to produce a wound. The parts of the primitive stone arrow-head are the tip or apex, faces, sides, base, shank or tang, barbs, and facets.

Arrow-straightener, a piece of bone, wood, or ivory, with a perforation to serve as a wrench in straightening arrow-shafts, barbs, etc.

Barb-piece, the piece of ivory, etc., on some arrows attached to the true head, and having barbs on the sides. This should be carefully discriminated from the foreshaft, which has another function altogether.

Base of an arrow-head, the portion which fits into the shaft.

Bow-shot, the distance to which an arrow flies from a bow.

Chipper or *flaker*, the pointed implement of bone, antler, etc., used for shaping flint arrow-heads, spear-heads, etc.

Cock-feather, the feather of an arrow which is uppermost when the bow is drawn.

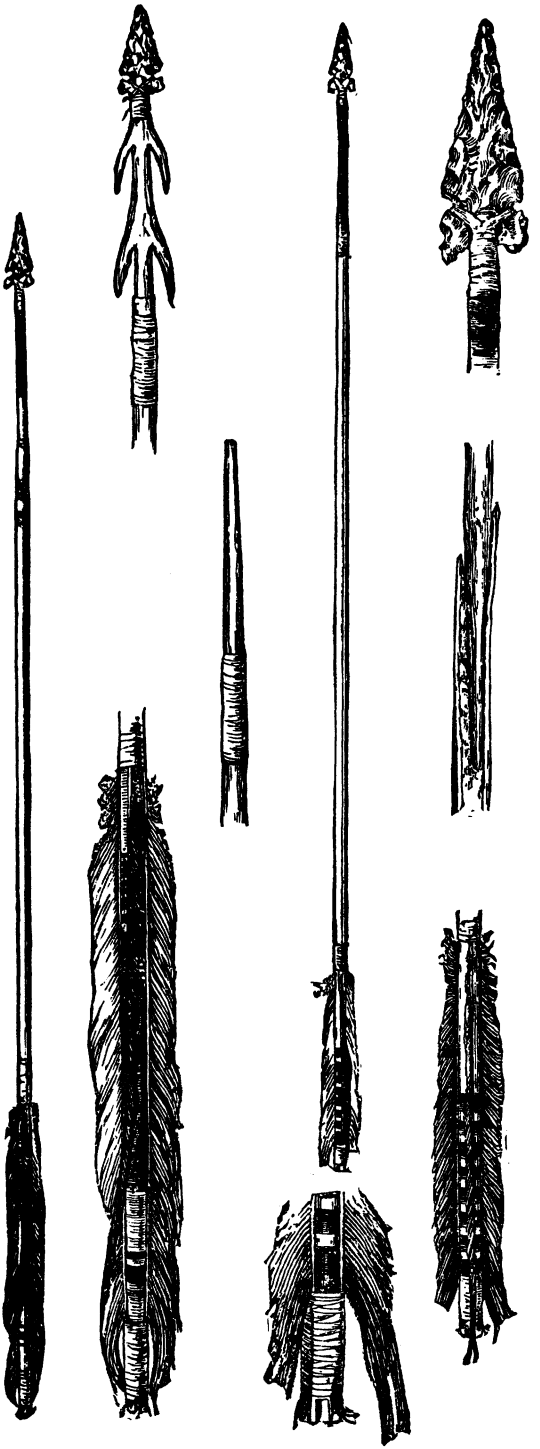

FIG. 5—Analysis of the arrow.

Faces, the broad, flattened portions of an arrow-head.

Facets, the little surfaces left by chipping out a stone arrow-head.

Feathering, the strips of feather at the butt of an arrow, including the method of seizing or fastening.

Flaking hammer, called also a hammer-stone, a stone used for knocking off flakes in making flint arrow-heads, etc.

Fletcher, an arrow-maker; akin to *fleche*.

Footing, a piece of wood inserted in the shaftment of an arrow at the nock.

Foreshaft, a piece of hard wood, bone, ivory, antler, etc., at the front end of an arrow to give weight and to serve for the attachment of the head.

Nocking, placing the arrow on the string preparatory to shooting.

Pile, the head of an archery arrow; any arrow-head may bear the same name, in which we may have a one-pile, two-pile, three-pile arrow, etc.

Pitching-tool or knapping-tool, a column of antler or other hard substance used between the hammer and the core in knocking off flakes of stone.

Riband, a term applied to the stripes painted on arrow-shafts, generally around the shaftment. These ribands have been called clan-marks, owner-marks, game-tallies, etc.

Shaft, anciently an arrow, but strictly the portion behind the head, and in a fore-shafted arrow the lighter portion behind the fore-shaft.

Shaft-grooves, furrow cuts along an arrow-shaft from the head backward; they have been called blood-grooves and lightning-grooves, but these names are objectionable as involving theories.

Shaftment, the part of an arrow on which the feathering is laid.

Shank or *tang*, the part of an arrow-head corresponding to the tang of the sword-blade.

Sides of an arrow-head, the sharpened portions between the apex and the base, also called the edges.

Stele (stale, shaft), the wooden part of an arrow; an arrow without feather or head.

Tip, a term applied to the sharp apex of an arrow-head.

Trajectory, the curve which an arrow describes in space; may be flat, high, etc.

Whipping (seizing, serving), wrapping any part of a bow or arrow with cord or sinew regularly laid on.

There are some nice questions concerning the arrow which my colleagues will discuss; others are yet in doubt. I do not think we are yet authorized to say that all tribes distinguished the rhomboidal hunting arrow head from the barbed war arrow head. The shaft streaks are called blood grooves by some writers, lightning grooves by others. In the one case the motive is practical, in the other it is magical. The grooves are present on many arrows—long straight channels, zig-zag lines, broken lines, and so on. The reason assigned by the ordinary Indian has never satisfied my own mind, although the magical reason seems to me nearer to his psychical state.

MANUFACTURE OF STONE ARROW-POINTS.

BY W. H. HOLMES.

The arrow-point was usually made of some material firmer and heavier than the shaft, and was attached by means of thongs and cement. Its purpose was to insure greater accuracy and range, and to give greater penetrating power to the weapon. Stone, though apparently but poorly adapted for such a purpose, has been very generally employed by primitive man, as the countless numbers of flaked points scattered over the face of the country amply testify.

It is not possible in all cases to distinguish points made for the arrow from those made and employed for projectiles thrown by the hand, or throwing stick, or from those intended to be hafted and used as knives, daggers, drills, and the like. It is not unlikely that many points were alternately used for a number of purposes as necessity demanded. In genesis the stone arrow-point is substantially identical with other similar objects of flaked stone. The knowledge and the skill that enabled the savage to secure and shape the stone in one case served equally well in all others.

The implement of chipped stone found in the hands of our aborigines was evolved through a succession of more elemental forms, but the series of steps from the earliest form to the finished tool of the highest type cannot be definitely traced; in a way, however, the progress of manufacture of each individual of the highest type repeats the steps of the evolution of the species or group to which it belongs. This becomes apparent when it is observed that the act concerned in producing the first flake has but to be repeated with proper modulations and refinements to produce the elaborated object.

The materials suited for flaking are very numerous. Those in ordinary use in this country include vein quartz, chalcedony, agate, jasper, flint, hornstone, chert, novaculite, slate, argillite, quartzite, and obsidian. Rare forms, such as quartz-crystal, carnelian, amethyst, opal, etc., were also employed when available.

Primitive man became a mineralogist almost with the first use of unworked stones, for he had to consider grain, density and toughness, and it was not long perhaps before color and translucency became important considerations through the association of ideas of a mystic nature. Little by little and through a long series of exploitations and experiments he learned to utilize all suitable stones that came within his reach.

When an implement of chipped stone was to be made it was necessary first to secure the raw material. Erosive agencies had scattered countless fragments of flakable stones over the face of the country, and these were gathered and used; but when such materials became scarce or were not within convenient reach, excavation was resorted to. This led to the discovery that freshly exhumed stone was more easily and surely worked than that seasoned by long exposure, and the art of quarrying came into existence. Quarrying began with the removal of a buried or partially buried stone from its bed in the soil and culminated with the removal of hills and the tunneling of mountains.

The conditions under which the various rocks exist are greatly varied. Slate, quartz, quartzite, chert, obsidian, and indeed nearly all forms are constituent parts of the solid rock-mass of the earth. In this form even civilized man finds them extremely difficult to detach and remove, and savage ingenuity must have been taxed to the utmost to secure the necessary supply. In many cases nature has done much to lessen man's labor in this respect. It happens that in past ages all varieties of rocks were extensively broken up by the dynamic and erosive forces of nature, and countless numbers of fragments descended into the valleys and were taken up by water and ice and rolled and rounded and finally deposited in beds of gravel along the banks and especially about the mouths of rivers. In this rolling process all the soft and friable stones were reduced to powder and the tough, flinty, flakable pieces were selected and preserved as if by intelligent design for the use of the stone-age man. These bowlders were much more readily quarried than the same rocks in their original beds. Equally convenient for use were certain nodular

forms of flinty rock which are commonly weathered out, but which were also to some extent quarried.

When detached fragments, bowlders, and nodules were not sufficiently plentiful or ceased to be desirable for working, the rocks in place were attacked, bowlders were removed from their beds, splinters were broken from exposed masses of rock, and ledges were followed deep into the earth.

In Arkansas there are pits dug in the solid rock—a heavily bedded novaculite—to the depth of twenty-five feet and having a width of one hundred feet or more. In Ohio and in other States similar phenomena have been observed.

In the District of Columbia extensive quarries were opened in the gravel-bearing bluffs, and millions of quartzite and quartz bowlders were secured and worked.

The extent of this native quarrying industry has not until recently been realized. Such work has been considered beyond the capacity of savages, and when the ancient pits were observed they were usually attributed to the gold-hunters of early days, and in the South are still known as Spanish diggings. From Maine to Oregon and from Alaska to Peru the hills and mountains are scarred with pits and trenches. The ancient methods of quarrying are not well known, and up to the present time no tools have been discovered save rude hammers of stone improvised for the purpose. Picks of bone or antler and pikes of wood were probably employed. Associated with these pittings are ample evidences of the object of their excavation. Great heaps or encircling ridges of refuse, in cases containing hundreds of tons of the refuse of manufacture—fragments, flakes, failures, and tools broken in use and deserted when the work ended—are found. A study of this refuse usually indicates clearly and fully the nature and extent of the work carried on.

The raw material having been secured, the work of shaping began. The steps in this work were in all cases essentially the same, although they varied in detail with the material, the form to be produced, and the skill of the workmen concerned. Obsidian and other easily flaked stones were broken into masses, so shaped as to facilitate the subsequent removal by special processes of flakes for knives and projectile points. These masses became the cores so frequently found among our ancient remains, and were drawn upon when occasion required. In other cases simple flakes suited for subsequent specialization were made or were selected from the refuse on the site of supply

and carried away; and again suitable pieces were selected and reduced on the spot to a form approximating the final object. In all of our great quarries this latter appears to have been the leading feature of the work done. These flakes and roughed-out forms were the blanks, tested for material and reduced to approximate form, and to a size convenient for transportation, to be chipped into specific shapes when and where it suited the purposes of the possessor. In case of many of the great quarries little or no finishing was done upon the sites.

In most cases the shaping operations carried on in the quarry can be followed out with reasonable certainty. On all sites where the raw material was extensively worked, series of forms can be secured illustrating every stage of the morphology. These series begin with the amorphous mass or natural shape, and pass through a succession of modifications, ending in the rude blade or blank. The making and collecting of flakes and fragments to be carried away in an unshaped condition, although undoubtedly carried on in all quarries and upon sites of other sources of raw material, leave little or no refuse that can be studied to advantage.

Large masses in quarries or on simple shop sites were reduced by means of rude hammers with or without hafting. Fire was often employed as an auxiliary in this work. Approximate masses were reduced to more definite shapes by a succession of free-hand blows. The first step in the shaping of an implement from a bowlder is illustrated in Fig. 6. In this work the free-hand blow is employed for the reason that no other method would be efficacious. Fig. 7 illustrates the position in which the partially shaped mass must be held after its margins have become too sharp to be split by a blow directly upon the edge.

When the incipient implement became too attenuated or fragile to withstand the blows necessary to flaking without imminent danger of breaking, other methods had to be employed. The statement has been made by some writers that arrow-points are produced by simple percussion, the hammers being reduced in size to correspond with the increasing fragility of the object worked. This process, however, must be exceptional.

Instances are recorded in which indirect percussion—that is, the use of a mallet and punch—was employed in removing flakes intended to be shaped by pressure. Two varieties of indirect percussion are illustrated in Figs. 8 and 9. The first is practiced by the Wintuns

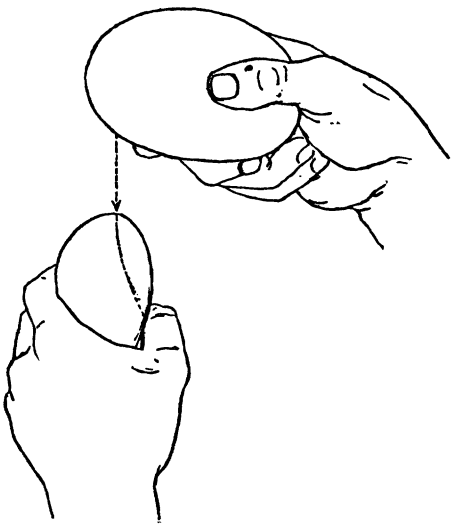

FIG. 6.—Free hand or direct percussion; first step in shaping an implement from a bowlder.

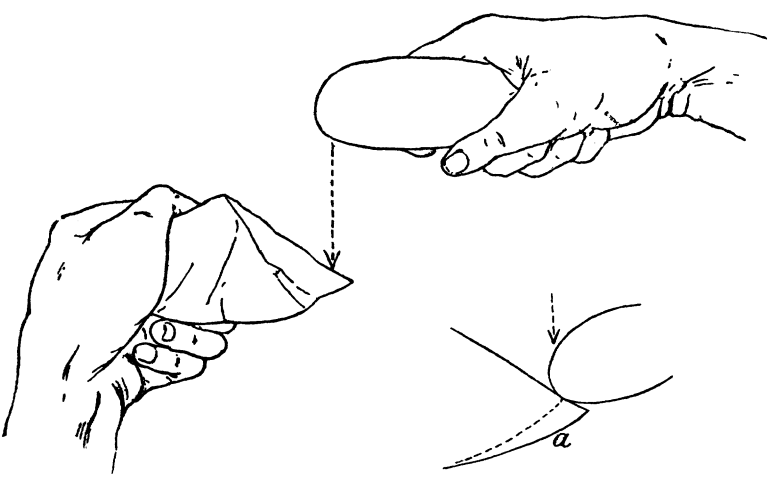

FIG. 7.—Direct percussion; manner of striking where the edge is sharp.

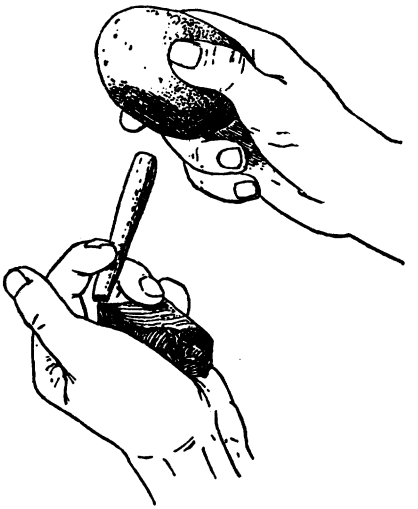

FIG. 8.—Indirect percussion, as practiced by the Wintuns, and described by B. B. Redding.

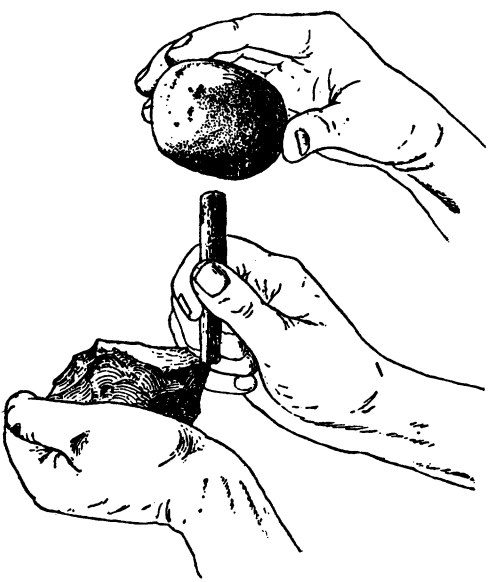

FIG. 9.—Indirect percússion, two persons being concerned; practiced by the Apaches, according to George Catlin.

of California and other tribes. The drawing is made from a very careful description by B. B. Redding. The second is derived from the observations of George Catlin. According to Catlin, the point is sometimes carried to a finish by the indirect stroke, two persons being employed in the operation, as shown in Fig. 9. As a rule, however, the method of manipulation was changed at the proper stage from percussion to pressure.

The blanks from the quarries—the roughed-out blades and selected flakes, as well as similar products from all varieties of sites—had acquired such outline, attenuation, sharpness of edge, and bevel when the change from percussion to pressure took place that the gentler method would be operative. It is probable that in many cases the work was transferred from operatives skilled in the blocking-out to others especially skilled in shaping by pressure; but it is also pretty certain that nearly every hunter was able, in case of necessity, to shape his own arrow-points, howsoever roughly, from the raw material.

The flaking of stone, and especially that part of it relating to the making of arrow-points, has very generally been regarded as a great mystery and is often spoken of as a lost art; but the art is still practiced by many of our aboriginal tribes, and it appears that almost any one who desires can by a little systematic practice do the work. Of course to acquire great skill much practice is necessary, but the methods are for the most part so well known and so simple that the mantle of mystery no longer enshrouds them.

When pressure is first suggested as an adequate means of flaking hard stones, doubt is usually felt as to its competency, and when it is stated that the tool used is not of metal or of stone, but of bone or ivory, incredulity is usually expressed; but the test is easily made.

A blank form or a flake having the approximate shape is held firmly between the fingers and thumb of the left hand. A firm piece of bone having a rather thin edge or angle like that of a three-cornered file is taken in the right hand and set upon the sharp edge of the stone and at right angles to it so firmly that a slight cut or notch is made in the bone, then with a quick, firm movement of the right hand, met by a similar movement of the left, the bone is made to move across the edge of the stone (Fig. 10), in doing which it takes with it a flake, varying in length, width, and depth with the skill and power of the workman, the nature of the stone, etc. A rapid repetition of this operation, accompanied by a proper resetting of the tool,

quickly reduces the piece, if it works readily, to almost any desired outline. The position and manner of holding may be changed, as

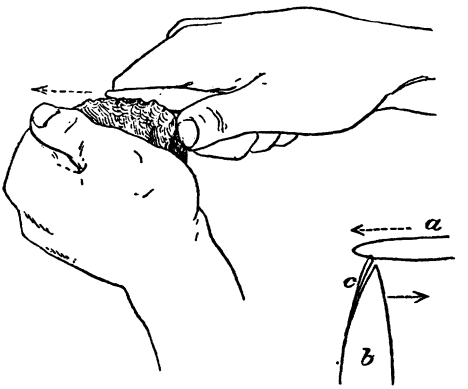

FIG. 10.—Flaking by pressure, a bone implement being used. *a* the bone tool, *b* the stone, *c* the flake.

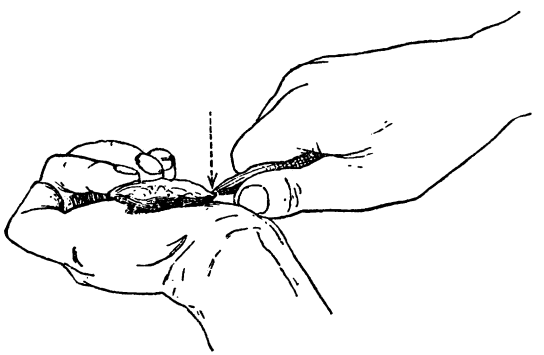

FIG. 11.—Flaking by pressure; manner of holding as observed among many tribes by J. W. Powell and others.

shown in Fig. 11. In both cases the hand holding the stone must be protected against cutting by the sharp flakes by a piece of buck-skin or leather. This is true of some of the other cases illustrated.

The same result may be obtained in various other ways, but always by means of suddenly applied or spasmodic pressure. Numerous methods of applying this pressure are known. The blank may be held down

by the fingers upon the edge of a table or board, as shown in Fig. 12, and the point of the bone or of a bit of metal as well, held in the other hand, may be set so as to catch the edge of the stone to a width corresponding to that caught by the notched bone in the other position, when a quick downward pressure upon the flaking-tool will remove the flake. Again, in larger work, where greater force is required to remove the flakes, a tool long enough to place against the arm or

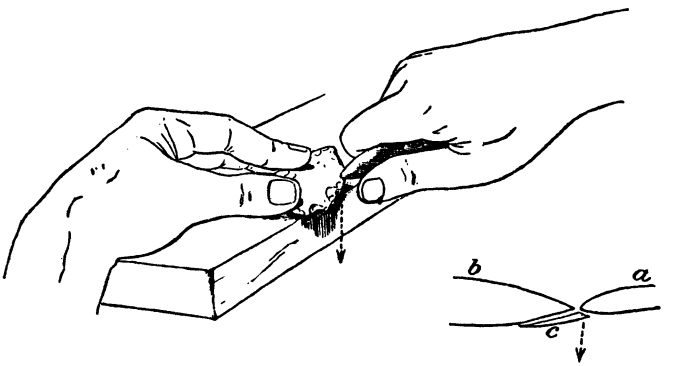

FIG. 12.—Flaking by pressure, a bone point being used, the implement to be shaped resting upon a support.

chest of the operator may be used. In this way much additional force is thrown into the spasmodic movement. Another device consists of a notched or forked bone or pincers, which is set upon the sharp edge of the blank and given a sudden twist, thus removing the flake (Fig. 13).

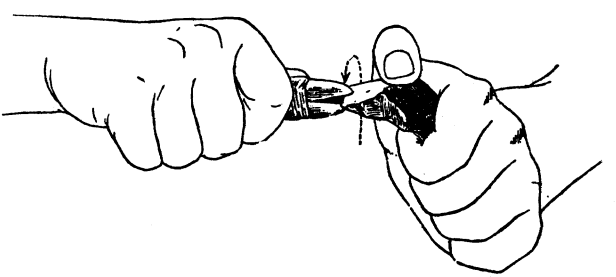

FIG. 13.—Flaking by pressure, bone pincers being used.

Methods vary with different peoples and differences in the material lead to variations in treatment by the same people. Eye-witnesses have described the processes employed by many widely separated tribes, but extracts from these records would add too greatly to the length of this sketch.

FORMS OF ANCIENT ARROW-HEADS.

BY THOMAS WILSON.

The arrow-heads, spear-heads, and knives of the prehistoric races have such likeness of form, style, and size that a line of division between the three is practically impossible. A small implement may be an arrow-head; a large one of the same type may be a spear-head, while either or both may have served as knives. The distinction might be better made if the shafts or handles remained; but these, together with the lashings and attachments, have decayed and disappeared, except when bitumen or gum has been employed.

An implement of this kind, whether large or small, with a light, long shaft, would be an arrow; the same with a heavy, long shaft would be a spear, while either of them with a shaft and lashing, but *short* instead of long, would be a knife or dagger. Indeed an implement of the latter class might be accidentally made through the breaking of the shaft of a spear or arrow; but none of these implements of the real prehistoric man have been found with their shafts or handles and lashing fastenings, and so we are driven to theory for their name and uses.

The classification of stone arrow-heads, spear-heads, and knives has been attempted by few archæologists and with but slight success. No classification has as yet been generally adopted. Those heretofore attempted have been too complex, the divisions have been too close, and the distinctions not sufficiently broad to be popular. A classification of infinitesimal divisions, with slight differences, difficult to distinguish and still more difficult to remember, will never be satisfactory or acceptable.

I have attempted the following classification for these implements in the Department of Prehistoric Anthropology of the National Museum, believing it to be free from the foregoing objections, and yet to be broad enough to include practically all the implements of this kind made or used by prehistoric man.

The series of outlines presented in Fig. 14 will assist in giving a clear understanding of the forms described.

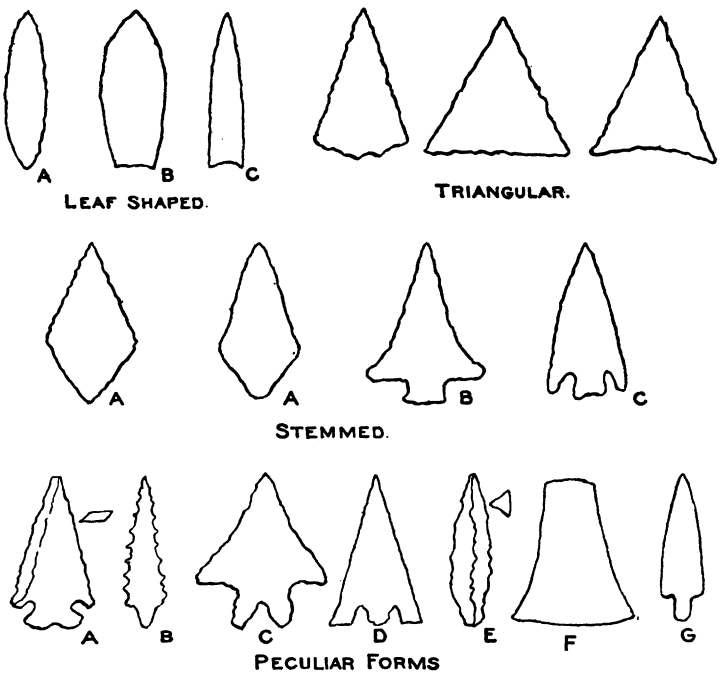

FIG. 14.—Types of arrow points.

Leaf-Shaped.—Sub-class A.—Thin and usually finely chipped implements of the form of a laurel leaf—elliptical, and pointed at both ends. This includes the French Solutrēen type of the Paleolithic period of the Stone Age.

Sub-class B.—These may be thicker and ruder than sub-class A. Some are more oval, and the bases are not pointed, but are either straight or convex. This class includes the leaf-shaped argillite implements found by Dr. C. C. Abbott in the Delaware river gravels at Trenton, New Jersey.

Sub-class C.—Long, thin blades, with nearly straight edges, more like a dagger or poignard. The base may be either convex, straight, or concave. Many of them show traces of attachment to a handle by means of bitumen or gum. They are peculiar to the Pacific slope.

Triangular.—This class includes all forms approaching a triangle, whether the bases or edges be convex, straight, or concave. They are without stems, and, consequently, without shoulders, but in some specimens the concavity of the base produces barbs.

Stemmed.—This class includes all varieties of stems, whether straight or expanding, and all varieties of bases or edges, whether convex, straight, or concave.

Sub-class A.—Lozenge-shaped, rude, and indefinite stems.

Sub-class B.—Shouldered, but not barbed at the shoulder. In occasional specimens barbs are produced at the base, but only by its concavity and width.

Sub-class C.—Shouldered and barbed.

Nearly all of the convex bases are smooth, as though worn. The purpose of this is unknown.

Peculiar Forms.—These have such peculiarities as to distinguish them from other classes, but are restricted in number and locality.

Sub-class A.—Beveled edges; the bevel is almost always in one direction.

Sub-class B.—Serrated edges.

Sub-class C.—Bifurcated stems.

Sub-class D.—Extremely long barbs, usually square at the ends.

Sub-class E.—Triangular in section.

Sub-class F.—Broadest at the cutting end—*trenchant transversal.*

Sub-class G.—All those made of slate and polished.

Parts of stone arrow and spear heads or knives are: Point, base, side, edge, shoulder, barb.

ARROW FEATHERING AND POINTING.

BY WALTER HOUGH.

The attachment of points and feathering to modern arrows casts light upon ancient methods of arrow pointing and is more or less valuable ethnographically.

Materials.—Sinew is the most important material in the kit of the arrowsmith, being pliable when damp, splitting into even threads, becoming horn-like on drying, and binding parts strongly together on shrinking.

American Indian arrows, with very few exceptions, are lashed with sinew. In other parts of the world, however, sinew is not so gen-

erally employed. A glance over the collection of 2,500 arrows in the United States National Museum reveals the fact that African arrow-heads and feathering are fastened on with grass, palm-leaf strips, and other vegetable fibres, while sinew is comparatively rare. Many African arrow-heads are socketed or tanged, and therefore not lashed at all. Polynesian and New Guinea arrows are also served with vegetable fibre, the Ainos use bark, and in South America many tribes lash with natural fibres.

Glue or other cement is used by most tribes. In Angola caoutchouc is employed. In the southwest part of the United States mesquite gum, perhaps mixed with other ingredients, pine resin, etc., form readily available materials.

Methods of Mounting.—While complete arrows in museums often show plainly the methods of mounting, yet there are details only to be learned by watching the arrow-maker at work and by observing the "tricks of his trade."

It was my good fortune lately to see an Apache manufacture and set the points and feathering of arrows. Apache arrows are gen-

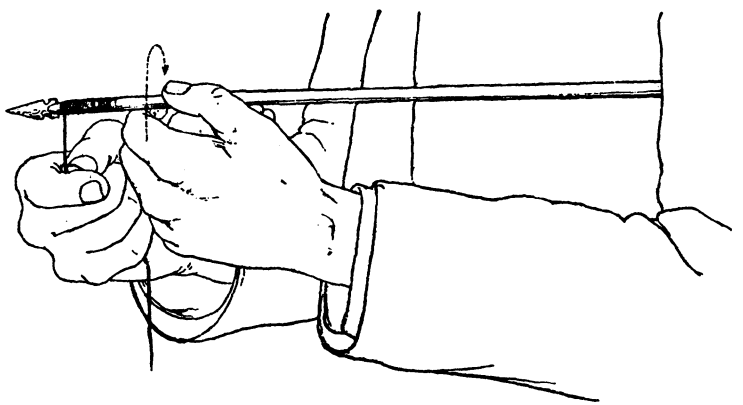

FIG. 15.—Fixing the point in the shaft by wrapping.

erally made of *tule* reed set with wooden foreshafts, the latter indispensable in mounting the head, as the reed cannot well be tapered. A nick is cut in the end of the foreshaft, a little pellet of gum is placed in the nick, set on fire, and allowed to burn for a moment; then the arrow-head is thrust into place, quickly lined with the shaft, and the gum smoothed down carefully. Sinew is then laid around the arrow below the point (Fig. 15), care being taken lest the

turns overlap. As the sinew is wound nearly to the base of the head, it is thrown over the tangs at alternate turns, forming a cross. Finally the cement is called into requisition again for the purpose of fastening off the sinew.

Sometimes the heads are set deeply into the shaft and the sinew served continuously around the arrow to some distance above the barbs, giving strong socketing and protecting the sharp angles as well as allowing better penetration. This usage is found among the Indians of northern California, who are pre-eminent as arrow-makers.

Arrows with points or foreshafts merely sharpened or with blunt or knobbed heads, the latter variety often unfeathered, are met with everywhere. Feathering is not required on such arrows, since the shaft follows the head as a string lines with a moving ball.

Feathering.—The feathering is made by splitting a strong feather and spacing three of the parts at the base of the arrow. A turn of sinew is first made to hold them in place, then they are bound on and trimmed to a gauge. Some tribes also fasten the feathers with glue; others bow or spring the feathers to aid the flight. The Point Barrow Eskimo fasten the feathers by forcing the extremities of the feather shaft into the soft wood with an ivory punch. In African arrows the wrapping thread is carried through the barbs of the feathers without disarranging them. Most arrows have triple feathering. The Eastern Indians can only be conjectured to have followed this rule, since there are no specimens of this art in existence and it is doubtful if records are minute enough to note this point. Some of the Cherokee arrows collected by Mr. James Mooney, however, have two feathers and are rifled. The Dog Rib and Iroquois Indians also used only two feathers. The Northwest Coast arrows have two entire stiff feathers lying flat against the sides of the shaft, seemingly devised to rotate the arrow. This style begins on the Columbia river and, with a few exceptions, follows the Eskimo coast fringe to Labrador. A notable exception occurs on the Yukon river and delta, where superior arrows are made. The Pima of Arizona are the only Indians south of Oregon in the western United States who employ a two-feathered arrow. The double feather reappears in British Guiana, on the Amazons, and in Terra del Fuego. In the first two localities mentioned rifling is also rather common. African arrows are the only ones in which I have observed multiple feathering, running from triple to octuple or higher.

In general, rifling the feathering is unusual. In many cases it is, perhaps, an adventitious result, though undoubtedly designed in the Pima arrow and in one specimen from the McCloud River Indians. If the Pima and Mohave arrows are all rifled, as indicated by the Museum specimens, the double feathering is explained, since rifling by means of three feathers would render the aim bad by jostling the arrow when the feathering crossed the bow. With two feathers a clearer space is left. In the Pima arrow the rifling is designed, as the feather from before is but slightly curved for some distance, then is lashed with sinew, bent more sharply, and lashed again, etc., until the turn is quite marked near the nock. Nearly the same plan is pursued in the McCloud River arrow. The rifling curve is usually small, being rarely over 90° in 4-5 inches.

It seems not a little remarkable that rifling, which is supposed to be a modern invention, should be discovered and practiced by savages; but it is undoubtedly true; and it is possible that the "beveled" arrow-heads of camp sites were designed to effect the same rotary motion.

It is the usage of some Indian tribes to leave a trail of long barbs on the feather near the nock. Very often the Sioux allow the downy plumules at the junction of the shaft and quill of the feather to remain, giving a finish and probably a tribal mark. The ornamentation of the arrow also affords tribal marks, notably among the Indians of the United States.

THE ARROW IN MODERN ARCHERY.

BY WESTON FLINT.

The remark of the old Indian, that anybody could make a bow but it took a great deal of skill to make a good arrow, is equally applicable to the arrows of the modern archer. In fact, the quality and make of the bow is far less important than the arrow itself.

It has been well said that with a poor arrow even Robin Hood himself would have drawn the long bow in vain.

From the large exhibit of arrows presented here to-night, it is readily seen that they are all very similar in their efficient characteristics. From the prehistoric specimen of the Cave-dweller to the latest skillful manufacture of Aldred or Horseman, the arrow is the same in general construction, the great difference being in the ma-

terial used and the greater or less care bestowed upon them. The differences in modern arrows are very much the same as in those of older date.

I have only time to show the essential features of the modern arrow, and to state that in the change of the use of the arrow from an instrument of warfare and hunting into an instrument of skill and precision in the modern sport of archery, very little change of form has been made except in the pile or head.

In the modern, as in the ancient weapon, two things are essential for a perfect arrow: one is straightness, which is necessary to a correct flight, and the other stiffness or rigidity, so the missile may receive the whole force of the bow without flinching or flirting, as it is termed in archery.

Modern arrows are either self—that is, made of one piece of wood the entire length—or footed—*i. e*, the front part of the arrow is made of harder wood, into which the main part is set usually in a V shape. The four principal parts of an arrow are the *stele*, the *pile*, the *nock*, and the *feathering*.

The *stele* is the body of the arrow, which is generally of the same size throughout its length and about one-third of an inch in diameter. The usual form of the best target arrow has a straight stele—that is, of the same size from pile to nock; the chested form is smaller at the point, increasing to the feathering; the bobtail form is larger at the point and decreasing to the nock, and the barrelled is larger in the middle, tapering both ways. You will notice upon examination that all these various forms are found in nearly all these exhibits, ancient and modern, and that the best of whatever nation or tribe are those conforming most nearly to the modern type, especially in regard to the stele. For target arrows old deal or pine is the best, but for hunting the stele may be of hickory, ash, elm, or pine.

The pile (*pilum*, a javelin) is the steel head, with bevel point for target shooting, and was so named from a regulation of Henry VII for keepers of the royal forests, who were obliged to use the blunt pile on account of the game; hence this became the general term for the point of the arrow. The pile for most purposes very slightly diminishes in size toward the point and ends with a blunted cone. The sharp pile is made still smaller toward the end, and the old sharp pile is a long cone ending in a sharp point. The round-ended is like the first, with a round end instead of a cone.

For the proper hunting arrow, now rarely found, a flat-barbed metal point was used, which was attached by a wrapping of wire, and this was done in much the same way as the fastening of the stone point by the Indians, previously described by Mr. Hough.

The *nock* is made of horn, with a notch or slit in which to receive the string. Its proper construction has much to do with the precision of the flight of the arrow. It must be just large enough to let the string loosen easily when the bow is drawn, and, on the other hand, must be small enough not to allow any vibration on the string.

Last, but not least, is the *feathering*. Most arrows have three feathers, a very few, two. In proper modern archery there are always three feathers, and these are arranged on the sides of the arrow near the nock, parallel with the stele and equidistant from each other, at an angle of 120 degrees; one feather, called the cock-feather, is always at right angles to the nock. This arrangement avoids injury to the feathers when the arrow is loosed. Experiments have been made with arrows feathered on a spiral to make the arrow turn like a bullet from a rifle, but with very poor results: first, because the feathering is injured in loosing, and secondly because this spiral motion rather retards the flight of the arrow without giving greater precision.

The length of the target arrow varies very little at the present time, being 28 inches for gentlemen and 25 for ladies; but expert bowmen will adjust the length of their arrows very accurately, so as to be able to draw to the full length in practice.

Roger Ascham quaintly says: "Our English yeoman who fought with Harry of Monmouth, at Agincourt, drew every man his cloth-yard shaft," and Paulus Jovius mentions the length as two cubits—that is, about a yard; but the statute of Edward IV provides that the arrow shall be three-quarters of the standard, and if this refers to the yard instead of an ell, as is most probable, the arrow used must have been 27 inches, about the standard length to-day. It is most interesting to note that this is just the old Flemish ell. Old King Lear says:

"Draw me a clothier's yard."

And in the Percy Ballads we are told:

"An arrow of a cloth-yard long
Unto the head drew he."

"The Lyttel Geste" of Robin Hode has also this line:

"And every arrow an elle longe."

From all these quotations it would seem that the length of the arrow was formerly a very important matter, as it is to-day.

The weight of the arrow of course depends somewhat upon the length, as whatever the length, it must be of sufficient size to prevent bending, and these weights are given in English silver shillings, from 4*s.* 3*d.* to 5*s.* 6*d.* for gentlemen, and from 2*s.* 6*d.* to 3*s.* 6*d.* for ladies. The proper balancing of the arrow is secured by weighting the point. In the case of target arrows the center of gravity is made to fall about one-third of the distance from the point. The flight-arrow for long-distance shooting is made lighter, much longer, and of different shape, often being smaller towards the nock, because distance, not accuracy, is the end desired. The balance is much nearer the head; the pile is rather blunt, more like a bullet, and the feathering is very light, some of the best arrows for distance having no feathering at all.

The one I used at a contest in 1883 was made from an ordinary reed with a weighted head, no feathers, and about 32 inches long. With this a flight shot of 272⅔ yards was made. Mr. L. W. Maxson, of this city, an expert in archery, made a distance of 296 yards, in this city, in 1884. This was with an unfeathered reed 33 inches long, with a leaden pile.

Some very practical lessons have been learned from the arrow in these later days. Four or five years ago, while the Archery Club was practicing in this city, General Meigs was much interested in the practice scores, and with Captain Bartlett, a member of the club, made a study of the practical use of the arrow in throwing over buildings fire-escape arrows with lines attached; and it was partly from experiments like these that the dynamite projectile, nearly like an arrow, was planned by Captain Medford and others. The projectile carrying the dynamite was made of various shapes, but all were modeled upon the plan of the arrow. They were constructed with a large stele with frustum-shaped base, or an oval head with small stem and a flanged, blunt cone at the base, which answered the purpose of the feather in guiding the missile through the air.

There has always been a great fascination in the use of the arrow, and the late revival of archery is not strange. Even as late as 1816

a silver arrow was shot for at the famous Harrow school, in England, founded by John Lyons, and an arrow was sculptured upon the old school-house and used to be stamped upon all the book covers provided by the foundation.

POISONED ARROWS.

BY DR. W. J. HOFFMAN.

In making a brief reference to the poisoning of arrows it is not practicable to discuss the philosophy of the question. Primitive man is not a toxicologist, and probably owes his knowledge of the effects of venom, vegetal poisons, and putrid animal matter, to actual observation. These effects, however, are in his mind attributable, not to septic or other poison *per se*, but to the supposed presence of malevolent spirits or demons which enter the body of the victim and destroy life. Apart from this, substances are employed also on account of their association with something peculiar to the plant or animal from which they may be derived, as will be observed farther on.

Poisoned arrows were apparently used in prehistoric times* in Europe. Later on, in the fourth century, Quintillian, lieutenant of Maximus, encountered the Franks upon a barricade of trunks of trees, from which height they threw poisoned arrows as from catapaults. Wounds inflicted by these weapons were sure to cause death.† The Celts and Gauls, according to Aristotle, Strabo, and Pliny, poisoned their arrows with the juice of a plant of the genus hellebore, called *lineum*. The Dalmatians and Daces employed the *Aster helenium*.‡

The Scythians, according to Aristotle, prepared their arrow poison by mixing serpent venom with the serum of putrid blood. Other instances are related in classic literature of peoples of the Black Sea and in Asia Minor who practiced similar arts, but the preceding allusions will suffice.

The Ainos of Japan prepare a poison which is spread upon bamboo or metal arrow-points. It is stated that game killed by this

* Bull. Soc. d'Anthrop, Paris, I, 1859, p, 51; also, Comptes rendus de l'Acad. des Sc., Paris, XLVI, p. 900.

† Gregory de Tours, *Historia Francorum*, lib. II, cap. V.

‡ Paul d'Egine, liv. XXXVIII, trans. by de Brian, p. 347. [Quoted from Lagneau, in Bull. Soc. d'Anthrop., Paris, 1883, p. 211.]

means is eaten without injury, a small portion of the flesh surrounding the wound only being cut away. The practice obtains to considerable extent in Java, Borneo, New Guinea, and other of the East India Islands, the famous Upas poison being obtained chiefly from *Strychnos tiute* and *Antiaris toxicaria*.*

The practice of poisoning arrows prevails extensively in Africa, the most conspicuous localities being the west coast, in the Gaboon, among the Somali, in the neighborhood of Bunder Marayah, and among the Bushmen. The latter employ the juice of a *Euphorbia* mixed with the pulp of a venomous worm. A certain species of bulb—*Hæmanthus toxicarius*—also enters into the composition of one variety of poison.

The best known and most active of arrow poisons is the Woorara or Urari, of the northern portion of South America. Drs. Hammond and Mitchell† have published extensively their researches regarding this substance. This is chiefly used on the tips of darts blown from the *sarabacana* or blow-gun. The composition varies somewhat, according to the tribe making it. The chief active ingredient appears to be the juice of *Strychnos toxicaria*, though to this are added other vegetal substances and serpent venom. This poison is known under a variety of names, according to locality and tribe. In Central America poisons are also used, both upon arrows and blow-gun darts. The Caribs employed a poison made from the sap of a tree termed the "Mancenilles."‡ The antidote was the application to the wound of a poultice of a farinaceous substance, which subsequently became known to us as arrow-root. The natives of Florida are reported by various authors to have been acquainted with arrow poison, and Pontius, when in search of the Fountain of Youth, is said to have been wounded by a poisoned arrow, from the effect of which he died.§

Considering the status of the Nahuatl or Aztecs and their geographic position, surrounded by peoples familiar with this practice, it appears rather singular that no reference is made by any of the historians to the use of poisoned arrows, although possibly they

* Lechenault, Ann. du Mus. l'Hist. Nat., Paris, XVI, 1810, pp. 459-482.

† Am. Journ. Med. Sci. Philada. (n. s.) XXXVIII, 1859, pp. 13-69; also Physiological Memoirs, W. A. Hammond, M. D., Philada., 1863, 271-294.

‡ César de Rochefort, Histoire Naturelle et Morale des Isles Antilles de l'Amerique. Rotterdam, 1681, 526.

§ Peter Martyr, lib. III, cap I.

possessed a knowledge of poison for internal administration, as is indicated by the statement that Tecocis, the predecessor of Axayaca, son of Montezuma, was poisoned because of his cowardice and aversion to war.*

The Seris of northwestern Mexico prepared poison by putting into a hole in the ground a cow's liver, rattlesnakes, centipedes, scorpions, etc., and beating them up with a stick. Into this mass the arrow-points were dipped.† The Jovas and other tribes of the same region also prepared a deadly poison. The Apaches and several neighboring tribes were, until recently, in the habit of smearing upon the arrow-head and foreshaft a mixture said to consist of decomposed deer liver and rattlesnake venom. In some instances crushed red ants, centipedes, and scorpions are also reported to have been used. An examination of such a coating upon arrows obtained from Apache Indians in 1871 showed the presence of blood corpuscles and a crystalline substance apparently identical with viperine (Bonaparte) or crotaline (Mitchell), the acting principle of crotalus venom. It remains to be learned how long such venom will retain its active properties, as wounds inflicted did not present symptoms of crotalus poisoning, but of septicæmia. One instance mentioned to me was originally but a mere scratch upon the upper portion of the scapula, but previous to death the flesh fell from the back as far down as the nates, exposing at various points the ribs and spinal processes. Dr. Lauderdale, U. S. Army, also informed me that he had observed the practice among the Apaches as above stated. Instances of the treatment of poisoned-arrow wounds are also on record.‡

The Lipan Apaches dip arrows into the sap of the *Yucca angustifola*, which they claim is very poisonous. Ordinarily the fleshy roots are eaten without the slightest hesitation. The leaves of the plant are sharply serrated, and it is believed by the Indians that the points possess a mystic power which will affect the victim. For a similar reason the Sisseton Sioux employ the small spines of the *Opuntia missouriense*, which are mixed with grease so as to make them adhere to the surface of the weapon to be anointed. Bullets are also prepared for the reception of this mixture by making small holes with a sharp-pointed instrument in which the spines are placed.

* Purchas, 1625, III, p. 1016.

† Hardy, Travels in Mexico, Lond., 1829, p. 298.

‡ Med. and Surgical Reporter, Philada., XIV, No. 17, pp. 321–324.

The Blackfeet, Bloods, and Piegans employ rattlesnake venom, as do also the Teton Sioux, the latter mixing it with the liver of deer or antelope and permitting the whole to become putrid. The Shoshoni and Bannack Indians state that the proper way to poison arrows, as formerly practiced by them, is to secure a deer and cause it to be bitten by a rattlesnake, immediately after which the victim is killed, the meat removed and placed in a hole in the ground. After the mass has become putrid the arrow-points are dipped into it. By this method the serpent venom is supposed to be the most essential in the operation; but it is extremely doubtful if the venom has time to fully enter the circulation in the short interval between the time that the victim is bitten and then killed. If the method was actually practiced by these Indians, as they affirm it was, and only for the destruction of noxious beasts, the poison of the putrescent matter may have caused death by septicæmia.*

The Pit River Indians of California are reported by several authors to have employed dog's liver mixed with the juice of the wild parsnip. From among the numerous other references to tribes indulging in the practice of arrow-poisoning I will mention but one or two. The Clallams of Puget Sound made arrow-points from native copper, or from fragments of this metal obtained from the sheathing of vessels, which were afterward dipped in sea water and permitted to corrode. The old chief, the "Duke of York," stated, however, that these arrows were never used against human beings. Such a statement may be taken for what it is worth, as I have yet to find an Indian who will admit the use of alleged poisoned arrows in warfare against man.

The natives on the Siberian side of Behring's Strait are said to dip their arrows in the liver of the white bear, which substance is mentioned as poisonous even while fresh.

I was told of a curious practice of the Aigaluxamūt Innuit, who endeavor to obtain pieces of flesh of a deceased whaler. The arrow-points are rubbed with this, after which the piece of flesh is worn as an amulet, in the belief that through it the wearer becomes possessed of the skill and powers of the whaler; and also that it insures accuracy of aim and success in the capture of game.

* For further description see Verhandl. Gesell. f. Anthrop. Ethnol. u. Urgesch, Berlin, 1880, pp. 91, 92; Bull. Soc. d'Anthrop de Paris, VI (III^e sér.), 1883, pp. 205–208.

In nearly all instances when poisons are prepared by Indians, either for internal administration or for the anointing of weapons or missiles, the operation is performed with more or less ceremony, chanting and incantation, for the purpose of invoking the aid of the evil spirits or demons; otherwise the compound would be ineffective.

REMARKS.

BY CAPTAIN JOHN G. BOURKE, U. S. A.

The arrows of the Apaches were specially well made. Their excellence was easily accounted for, as the main part of the shaft was made of the reed called in the Apache language the "klo-ka" or "arrow grass," which needed no straightening, whereas all those made by the tribes about them had to be straightened by a process which involved much labor and the loss of much time.

The myths of the Apaches relate that they first obtained their arrows from their gods, and that the tribe sprung from a reed swamp, and that the gods had put tips of obsidian on the shoulders of the Apaches, or, as we may make bold to translate it, had put the obsidian-tipped arrow in the quivers on their shoulders.

It is an interesting philological fact that the Apache name for bullet is "ka," or arrow. Our bullets, indeed, are only arrows propelled in a new way, as might be shown by making a vertical section of a bullet, which would be nothing more or less than a double-tanged arrow.

Mr. Edwin A. Barber, in the *American Naturalist*, described nine different kinds of arrow-tips. Each and every one of these various shapes could be seen among the Apaches to-day, and often in the same quiver several shapes would be found.

William M. Gabb, in Trans. Am. Philosophical Society, has shown that the natives of Costa Rica never barbed their arrows. Although the Apaches generally used barbs of obsidian or of sheet-iron, they also made them simply of triangular pieces of hard wood, and I have now in my collection specimens so made which in all respects resemble those first seen by Columbus upon reaching this continent. (See Letters of Columbus, in Hakluyt Society, vol. 2, p. 6, London, 1847.)

Fragments of beer bottles were utilized in making the arrow-tips,

and as far back as 1709 Lawson, in his account of the Carolina Indians, mentioned having seen such arrows. The accuracy of his statement was doubted by Squier and Davis in Smithson. Contrib., vol. 6, p. 213, but for what reason it would be difficult to say. There have been too many intelligent observers of the practice, which, after all, is a natural one, as brown glass so closely resembles obsidian that the Apaches call it "dolguini" (obsidian).

Indian Ballistics.—I have made it my business to ascertain whether or not the American Indian had such a science as ballistics, or the science of constructing bows and arrows according to standard measurements, dependent upon the height of the bowman. I found that such was the case, as may be seen by referring to my article in the last volume of this journal.* There it was shown that the flint or obsidian tips could be made in from five to eight minutes by the watch, and, contrary to what has been said, there did not seem to be any difference in the toughness of the material, whether buried under ground or exposed to the elements. This might be accounted for by the fact that Arizona is such a dry country, so little rain falling there.

In regard to the modes of feathering, I merely wish to supplement what has already been said. There seemed to be several methods, for each of which I have authorities; there was the method in use among the Apaches, of placing three feathers longitudinally and equidistant; there was the method of using only two feathers, as shown by Morgan, for the Iroquois (League of the Iroq., p. 306); by Mackenzie for the Hare Indians, (who, by the way, are Tinneh of the same family as the Apaches, who never use less than three)—(see Mackenzie, Voyages, London, 1800, p. 46), and by Cremony for the Pimas of Arizona (Life among the Apaches, p. 103). Some tribes gave a spiral twist to the feathers (see, for the Uabes of the Amazon, Wallace's "Amazon," London, 1853, p. 493; Corbusier, for the Apache-Yumas, in American Antiquarian, November, 1886; Mason, for the Hoopas, in "Science," and Morgan, for the Iroquois, as above).

On the other hand, there were tribes which did not appear to feather at all. See Gabb, as above, for the Costa Ricans.

Gómara, Torquemada, and Landa are the only known authorities upon the Indians of this continent who alluded to the proportions which should be observed in the making of the bow or the arrow.

* Vesper Hours of the Stone Age, vol. iii, p. 55.

Herbert Spencer's opinion that arrows had been made by "a differentiated class" did not seem to apply with correctness to our own tribes. The longest range that I can certify to is not much over one hundred and fifty yards, but the penetrativeness of the arrow is very great. I have seen them buried up to the feathers in pine trees, and have known one man, Mr. Kennedy, of Arizona, to have a headless arrow driven into his lungs. For references to this subject see the works of Mackenzie, Malte-Brun, Cabeza de Vaca, Espejo, and Domenech.

Amulets and Talismans.—Arrows which had been fired under any circumstances of special note became talismans, and were worn attached to the belt, bow, or hat of the owner.

Myths.—There were many references to the arrow, not alone in the myths of the Apaches, but of those of Durango, the Valley of Mexico, California, and elsewhere, as may be seen by citations from Bancroft, Torquemada, Boscana, and others.

While on this subject it might be well to remember that the Romans were called "Quirites," from a word signifying lance, of which they had made a god. See, among others, Salverte, "History of Names."

There are some reasons for believing that the act of divination by arrows, which prevailed extensively all over the Old World, had not been unknown to the aborigines of America. I do not feel warranted in asserting that belomancy did prevail, but instances of throwing arrows and stones "for luck" are given by Ross, Mackenzie, Castañeda, Picart, and Gómara.

Arrow-swallowing seems to have very generally prevailed throughout the American continent.

Reserve Ammunition.—Every Apache kept in the roof of his "jacal" an extra mulberry bow and a collection of reeds to dry for making arrows. Gómara, Sahagun, and Torquemada relate that at a certain time of the year each and every Aztec had to contribute to the public supplies a fixed number of arrows. The number is not stated, but the arrows were to be tied up in "bundles of twenty."

Defensive Armor.—Some of the American tribes have employed defensive armor made either of reeds or, as among the Aztecs, of quilted cotton, called the "escaupil." The Apaches have never employed anything except occasionally a small round shield of rawhide. This fact is noticed by Torquemada and Clavigero.

Poisoned Arrows.—I do not believe in the virulence, or rather in the permanence of the virulence, of the poison made from the putrid liver of deer into which an enraged rattlesnake had ejected its venom; at least, I can say that I have seen men and animals struck by darts alleged to have been so poisoned, but could not perceive that any extra harm had been done thereby. Columbus, according to Herrera, found poisoned arrows among the natives, and there are references to be adduced from Peter Martyr, Castañeda, Clavigero, Corbusier, Herrera, Alegre, and Giralamo Benzoni, the last being apparently the first European to tell the story that the natives of South America compelled their old women to prepare this deadly mixture, and if it did not half-kill the old women they were beaten nearly to death.

Fire arrows have been in use among the Floridians (Picart), the Sioux, and other tribes of the plains, as well as among bands living along the Rio de la Plata, in South America, according to Schmiedel, in Ternaux.

LANGUAGES OF NEW GUINEA.—Nos. 5 and 6 of the current volume of Petermann's Mittheilungen contain an interesting article by Hugo Zöller, entitled "Untersuchungen über 24 Sprachen aus dem Schutzgebiet der Neu-Guinea-Compagnie."

This article is based on the comparison of twenty-four carefully collected lists of the words in every-day use, and arrives at many valuable conclusions in regard to the relations of the different dialects in a region which has long been regarded as a veritable Plain of Babel. According to the officers of the New Guinea Company, who, naturally, have neither the time nor the inclination to make laborious scientific comparisons between the dialects, there are no less than one hundred entirely distinct languages spoken, in German New Guinea alone. This is, of course, an overstatement, but it is true, according to Herr Zöller, that languages at least as distinct as English and German are to be found within a half hour's journey of each other.